both x and z are varied, so as to obtain the limit which separates conditions leading to recovery from conditions leading to death.

In the third series, z is constant $= 1\cdot5$ (that is, a dose one-half greater than that which would produce death if no atropia were administered); and x and y are varied, so as to obtain sets of limiting conditions.

If the three variables, x, y, z, be expressed by means of a system of three rectangular co-ordinates, the conditions of each experiment will be represented by a point; and the points representing experiments resulting in recovery will be separated from those representing experiments resulting in death, by a surface passing through the points representing sets of limiting conditions.

The three series of experiments make us acquainted with three lines on this surface, viz., the intersections of the surface and the three planes, the equations of which are, $y = 5, y = -5$, and $z = 1\cdot5$.

Some further knowledge of the character of the surface may be obtained from a consideration of the general conditions. Thus, when no atropia is administered, the limiting value of z is obviously the minimum fatal dose of physostigma; that is, $x = 0, z = 1$. In the same way, when $z = 0, x =$ the minimum fatal dose of sulphate of atropia for a 3 lb. rabbit, = about 21 grains, or $z = 0$, $x = 21$.

Again, there must be a limiting value of y; that is, an interval of time so great as to prevent the two poisons acting simultaneously, the animal having either died or completely recovered from the effects of the first substance before the time for the administration of the second has arrived. When y exceeds this value, the surface must consist of two planes, the equations of which are, $x = 21$ and $z = 1$.

This limiting value is of course not necessarily the same on the positive and on the negative side; and, in fact, Dr. Fraser's experiments show that it lies very much nearer to the plane $y = 0$ on the negative than on the positive side.

Beyond these values of y, the surface consists of two plane sheets meeting in a rectangular edge. Each of these sheets separates points representing conditions under which recovery takes place from conditions leading to death; but in the case of the sheet $z = 1$ the space on the one side represents recovery and on the other side death caused by *physostigma*; while in the case of the sheet $x = 21$ the space on the one side represents recovery and on the other side death caused by *atropia*.

If we look closely at the portion of the surface lying between these limiting values of y, we shall see that here, also, the surface consists of two sheets; in the one $\frac{dz}{dx}$ is positive, in the other negative; in the one a small increase of the dose of atropia tends to recovery, in the other to death; the one runs continuously into the plane $z = 1$, the other into the plane $x = 21$. These two sheets meet in an edge, which is particularly well seen in the sections by the planes $y = 5$ and $y = -5$. (The various lines above mentioned are represented, in orthogonal projections, in the accompanying woodcut.) There can be no doubt that this edge is continuous with the rectangular edges between the plane sheets before mentioned. The conditions represented by points situated on this edge are such that increase of the dose of either substance will produce a fatal result, and that either increase or diminution of the dose of atropia will produce a fatal result.

This paper appears to us specially worthy of attentive consideration, as the first systematic investigation of the combined action of two poisons, and also on account of the method employed in arranging the results of the investigation; a method of which we have given a sketch in this notice, and which seems certain to lead to increased accuracy of observation, by giving the means of greater definiteness in the statement and classification of results.

NOTES

THE Royal Commission on Scientific Instruction and the Advancement of Science have this week examined the Marquis of Salisbury and Sir Stafford Northcote.

THE Anniversary Meeting of the Royal Society will be held on Saturday next.

AT the meeting of the Royal Geographical Society held on Monday night, the President stated that Mr. Young, the firm friend of Dr. Livingstone, to whom we recently referred, had sent him a cheque for 2,000*l.* to help to defray the expenses of the Livingstone Congo Expedition, which, under the command of Lieut. Grundy, who is well acquainted with the West Coast of Africa, is expected to start for Africa during the course of the present week. Government, we are glad to say, has given this expedition all the assistance in its power, furnishing letters to its officers on the West Coast of Africa, for the purpose of procuring the expedition all possible facilities. The War Office has made a present to the members of the expedition of the necessary arms, while the African Steamship Company has very kindly given to the officers passages at half the usual price. Lieut. Grundy thus starts under very favourable auspices. Sir Bartle Frere, the leader of the anti-slavery expedition from the opposite coast, left England last Thursday, and is expected to reach Brindisi in the course of a few days, where he will be joined by Lieut. Cameron and his party, who are just about to leave England. The party will then proceed, on board the *Enchantress*, through the canal to Zanzibar, where Sir Bartle Frere will give his final instructions to those gentlemen who are to form the expedition. The president, Sir Henry Rawlinson, places every confidence in Lieut. Cameron, and in the zeal of the officers by whom he is accompanied; he is determined to avail himself of every possible opening to penetrate into the interior of Africa, for his own credit, for the advantage of science, and for the purpose of aiding and relieving Livingstone.

THE Khedive of Egypt is also about to send a force comprising 5,000 men, under Purdy Bey (one of his American officers) to Zanzibar in transports. The ostensible object of the expedition is to go into the country which it is supposed that Livingstone may be exploring, and to co-operate with him, if it be agreeable to him; but if he declines assistance, the expedition would undertake on its own account a search for the sources of the Nile, where, if discovered, the Egyptian flag would be planted.

THE scientific news which comes to us every other week from France is refreshing and hopeful. There has been founded at Bordeaux a scientific association embracing the whole of the south-west of France, especially the Gironde and neighbouring departments. It is connected with the French Scientific Association, preserving, however, its autonomy and special organisation, its title being "Groupe Girondin" of the French Association for the Advancement of Science. Its seat is at Bordeaux, and, for scientific purposes, it is divided into four sections, each section corresponding to one or more sections of the French Association. They are—1. Section of the Mathematical Sciences; 2. Physical and Natural Sciences; 3. Medical Sciences; 4. Moral and Social Sciences. Each section meets monthly at Bordeaux, the first in the first week of the month, the second in the second week, and so on. The work of the sections consists of lectures, exhibitions, and scientific discussions on the subjects proper to each section. This provincial association intends to publish at intervals such papers as are likely to be of general interest; to encourage scientific researches by pecuniary help; and to give prizes for the best memoirs on subjects to be proposed by it. Most heartily do we wish the society success.

SIR JOHN BOWRING, whose death took place on Saturday last, at the age of eighty, was better known to the public in the world of politics than of science. In the latter, however, he filled a by no means unimportant position, as one of the most strenuous advocates of an international decimal system of weights and measures, and as an old and and very regular attender of the meetings of the British Association, where he devoted himself chiefly to the Section of Economical Science.

It is expected that Sir William Jenner will be the President of the Pathological Society for the ensuing year.

The Master and Fellows of Gonville and Caius College, Cambridge, have recently determined to appoint a prælector in chemistry to superintend the laboratory, and to have charge of the chemical studies of the students at the college. The stipend will be 200*l.* a year, and the prælector will have the status of a Fellow of the college. The election will take place about the middle of next month.

At a meeting of the Royal Society of Arts and Sciences of Mauritius, held on September 25, it was resolved that, like other scientific societies which have met in London the Society should convey to Dr. Hooker the feelings of regret and sympathy with which they have learned that differences had arisen between him as Director of the Botanical Gardens at Kew, and the First Commissioner of Public Works. It is the earnest hope of the Royal Society that Dr. Hooker, whom the Society has the honour to include among its members, as it did for many years his illustrious father, will succeed in maintaining himself with honour in the Directorship to which he has been raised by his merit and extensive knowledge, and which he has held with such distinction to himself and advantage to the public.

The Civil Service Commissioners have announced that on December 31 they will hold an open competitive examination for the appointment of clerk to the Curator of Kew Gardens. Candidates must be between the ages of twenty and thirty, and must be familiar with the routine duties of the garden, and competent to direct the foremen in matters relating to their accounts. On the same day the Civil Service Commissioners will hold an examination for the appointment of second assistant in the Herbarium at Kew, for which persons between eighteen and thirty who are skilled in practical botany will be eligible to compete. In each case the Commissioners will apply to Dr. Hooker for a report on the technical qualifications of the candidates.

The *Times of India* speaks of a rumour that the Government intends to abolish the Deccan College, or rather to amalgamate it with Elphinstone College. By this plan, Government pretends to think, higher education would be advanced in India. But the *Mora Prakash*, an Indian paper quoted by the *Times of India*, says the end would be much more effectually accomplished by appointing to both colleges a greater number and more efficient teachers than has generally been the case hitherto. For the two colleges there are thirteen professors; but Elphinstone College is allowed two Professors of Mathematics, while the Deccan College has none, and no Professors of History and Political Economy. We hope the threat is a mere bait to ascertain public opinion. Intelligent public opinion, we believe, would certainly condemn the step, and urge Government to make the teaching staff more numerous and effective.

A correspondent writes to the *Athenæum* :—"The question of admission of women to medical degrees in Edinburgh University has been rather unexpectedly solved, at least for the present. Miss Jex Blake, a foremost champion of the movement, has actually been plucked in her examinations, and sent back to complete her scientific studies." Many people will be quite unable to see that this by no means surprising accident affects in any way the great question of the unrestricted admission of women to the privileges of university teaching.

We are delighted to notice that the Liverpool *Daily Post* has for some time past been devoting about a column to science, giving, besides notifications of the meetings of the numerous learned societies in and around Liverpool, a selection of scientific notes from this and other journals. We cannot give too great praise for the step taken by this paper in the right direction, and we only wish that all other provincial, as well as metropolitan, papers would follow the example, and give the latest news of a power which a distinguished Frenchman recently declared would soon become the ruler of the world.

In a recent speech by the Rev. Mr. Tuckwell, he made some pertinent remarks on the Future of University Local Examinations. After referring with all due praise to the "Regulations of Oxford and Cambridge," he was yet compelled to say that without most serious modifications, the machinery of these examinations will be insufficient to meet the demand of the time which is surely coming, when compulsory universal public examinations will be imposed upon all the English schools. They show deficiency in four vital points. "They are administered by the older universities exclusively; but within the last forty years a race of teachers has grown up, who owe to an institution young yet already famous those feelings of loyalty and affection which some of us associate with the more venerable names of Oxford and Cambridge; and these men will give in their adhesion to no University examining body in which the London University remains unrepresented. They are costly to individual candidates: yet surely, from the wealth of the Universities and from the large educational endowments now in the hands of the School Commissioners, it would be possible to find funds for the extinction or the diminution of this tax. They unwisely limit subjects. Five optional subjects are permitted to junior candidates, of which Scripture must be one. They take up Scripture then because they must; Greek, Latin, and Mathematics, because these are supposed to gain higher marks than anything else, and are the leading subjects in their school work; there remains the choice between modern languages and science; nine boys out of ten, under the pressure of parents or teachers, take up French, and thus a severe though unintended blow is dealt at physical science. Lastly, they are in no sense compulsory; and the temptation to an unscrupulous master to pick out a clever boy, and work him exclusively for high distinction, while he starves the rank and file, is too obvious to need further notice. When these four blots are wiped away; when the three Universities combine to hold one great examination once a year; when the fees are lessened or abolished; when free trade in subjects is set up; and when all boys in every school above a certain age are compelled to undergo the ordeal; then, indeed, and not till then, we shall see such a system of examinations, so perfect in theory, so priceless in its effect upon school-teaching, as for the present we must be contented to behold only in our dreams."

An astronomical and meteorological observatory is about to be erected by the Russian Government at Tashkend, in Central Asia, about 100 miles north-west of Khokan.

The fossil man discovered at Mentone is at present being exhibited at the Jardin des Plantes, Paris.

Mr. W. F. Denning, of Bristol, noticed on Saturday evening last a meteor of considerable brilliancy. It radiated from a place at the extreme north-west part of Andromeda, passing through the sword-hand of Perseus, and onwards through Camelopardalus, becoming extinct, as if burnt out, on reaching the head of Ursa Major. In its flight the meteor faded several times and revived again with great rapidity. It did not leave any train of light marking the path it had traversed, though it emitted a spark in its course. In reference to its brightness Mr. Denning says that it excelled Venus when at her maximum degree of brilliancy.

Prof. Piazzi Smyth, writing to the *Athenæum*, says that the finest specimen of one of the "casing stones" of the Great

Pyramid known at present to exist either in Europe, or even in Egypt, was received last week in Edinburgh from Mr. Waynman Dixon, a young engineer who has recently completed an iron bridge across the Nile between Cairo and Jeezeh. The specimen possesses, Prof. Smyth says, in a more or less injured condition, five of the anciently-worked sides of the block, including the upper and lower horizontal surfaces, together with the levelled surface between. It was the exact angle of this levelled slope which led the late Mr. John Taylor to what Prof. Smyth calls "the immortal archæological truth, that the shape of the entire monument was carefully so adjusted and exactly fashioned in its own day to precisely such a figure that it does set forth the value of the mathematical term π, or does, vulgarly, demonstrate in the right way the true and practical squaring of the circle." Whether this be the case or no, Prof. Smyth declares that the length of the front foot of the stone, or that line or edge from which the angular π slope of the whole stone commences to rise, measures, "within the limit of mensuration error now unavoidable, the number of just twenty-five pyramid inches, neither less nor more. And twenty-five pyramid inches have been shown to be the ten-millionth part of the length of the earth's semi-axis of rotation." Prof. Smyth is very severe on the Egyptologists of the British Museum for the manner in which they conduct their department.

THE *Athenæum* informs us that the first volume of a Russian translation of Mr. E. B. Tylor's "Primitive Culture" has appeared at St. Petersburg. The German version of the same work is also announced as being just about to appear; and a French translation of Mr. Tylor's "Early History of Mankind," with notes by the translator, M. Emile Cartailhac, and by M. Quatrefages, is stated to be in preparation.

CONCLUSIVE proof has been obtained by a correspondent to *Notes and Queries*, that the treatise "On Probability" is not by De Morgan, but by the late Sir John William Lubbock. On inquiry at the Museum, the little slip of paper containing the original title was produced, and which gives the authorship to Sir J. W. Lubbock. On the back of the slip was inscribed the note—"Information from Prof. De Morgan, Dec. 62."

WE see from the *Times* of India, that Mr. Griffiths, of the Bombay School of Art, with a few of his students, intends, about the end of December, to go to the remarkable caves of Elephanta, to copy the very beautiful painted decorations which still cling to the walls, in spite of damp, neglect, bats, and the relentless teeth of time. These caves are on a small island in the harbour of Bombay, about seven miles S.W. of the city, and contain some very interesting Indian antiquities. They get their name from the gigantic figure of an elephant which formerly stood near the shore, but has now fallen to decay.

A CORRESPONDENT, Mr. W. B. Shorte, writes under date Nov. 4, from on board the steamship *Tanjore*, Bombay, giving us a few notes on the occultation of Venus, which he witnessed on the evening of Nov. 5. A small telescope with a magnifying power of about 100, and a pair of good binoculars, were the instruments employed. The planet shone with such lustre that it was clearly seen by the naked eye even before sunset, and after sunset appeared for some time as if resting on the upper part of the dark limb of the moon. In a few minutes a very gradual diminution of the planet's light was noticed, and as the occultation proceeded a singular phenomenon was observed, namely, the apparent position of Venus within the moon's circumference, the planet actually appearing for some time as if situated *upon* the disc of the satellite, though much diminished in size, and shining as a minute point of light. This continued until the moment of complete occultation, the Bombay time of which was 5h. 46m. 47s. The re-appearance on the illuminated edge occurred at 6h. 26m. 32s., so that the planet was invisible for 39m. 46s.

THE ORGANISATION OF ACADEMICAL STUDY IN ENGLAND

IN connection with the question of the best application of the endowments of Oxford and Cambridge, a public meeting was held at the Freemason's Tavern, on Saturday Nov. 16 by members of the Universities and others interested in the promotion of mature study and scientific research in England. The meeting was called in response to a preliminary resolution to the effect that "the chief end to be kept in view in any redistribution of the revenues of Oxford and Cambridge is the adequate maintenance of mature study and scientific research, as well for their own sakes as with the view of bringing the highest education within reach of all who are desirous to profit by it."

The Rev. Mark Pattison occupied the chair. He explained that gentlemen present were not the representatives of any political party or political movement, but were there simply for an academical purpose. Neither were they to be considered as having met to take an initiative: the initiative had already been taken by Mr. Gladstone in appointing a commission to inquire into the revenues of the colleges and universities. They were only there to discuss the direction which, in their opinion, ought to be taken by any reform, initiated, not by themselves, but by other people.

Professor Rolleston, who was the first speaker, commenced by remarking that until the end of the last century, it would be admitted that the Universities were neither seats of learning nor seats of teaching. The first thing that was done was to make them seats of examination; and, as far as that is concerned, they work tolerably well at this moment. The great danger is that they should be made simply into that utilitarian sort of machine—a machine for examining and a machine for teaching. The speaker by no means wished that their capabilities in the way of examining and that kind of work should be curtailed. Still he thought it of very vital consequence, in this somewhat utilitarian age, to make the Universities into places where original research, and where the production of fresh facts and means of knowledge, instead of the mere communication and reproduction of it, should be recognised. One result of our present examination system is that men who, as grown men and during the whole of their university career, are subjected to the ordeal of examination *in futuro*, do not look at what they have under study as so much truth, but look upon it as something to be reproduced on paper, and to further their designs on Fellowships and Scholarships, and other pecuniary rewards. Now when a man is kept for something like twenty-three or twenty-four years of his life under that sort of training, he gets apt to look at all work whatever of the intellectual kind, from the point of view of the examination merely. Men get demoralised by the process. They do not look at the truth for itself. They have no notion of shovelling forward the elements of knowledge into some area into which nothing has been before. That is entirely a new vein to them: and he thought one of the first things requisite was that examinations should be considered rather more the work of boys, and of people just emerging out of boyhood, than that they should be prolonged into a sort of struggle for men who have got to man's estate. We have then to consider:—how is it possible for us to encourage that which we feel is an advantage of a greater kind, although it is one which can only be shared by a larger number?—How is it possible to encourage original research without sacrificing soundness of learning in the many? How can we encourage the few to research without at the same time sacrificing the great advantages which we do get for the whole public, by passing a great number of mediocre men through the mill which does make them useful machines for doing work in this country of ours? There is a very serious objection which may be urged:—"But how do you propose to encourage original research? Original research is a work of genius—you cannot fetter genius by law—you cannot tie a man who has this gift of original research by rules and laws. You cannot give him definite duties to perform, within a definite time; and then you are in this dilemma:—a man has nothing given him to do—will he not then do nothing?" That is a very common saying among people who have got effectually case-hardened by looking at things in a schoolmaster's point of view. A man who has nothing to do, they tell you, will do nothing. Now he believed by using the system of examination judiciously, by rewarding people for what they do and show under that particular ordeal, and then by giving them something or another which does keep